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"..... per litora spargite muscum,
Naiades, et circum vitreos considite fontes:
Pollice virgineo teneros hic carpite flores:
Floribus et pictum, divæ, replete canistrum.
At vos, o Nymphæ Craterides, ite sub undas;
Ite, recurvato variata corallia trunco
Vellite mucosis e rupibus, et mihi conchas
Ferte, Deæ pelagi, et pingui conchylia succo."
N. Parthenii Giannettasii Ecl. 1.

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I.—*On Lepidosiren paradoxa, Fitzinger, and Lepidosiren articulata, sp. n., from Paraguay.* By E. EHLERS*.

IN November 1893 Dr. J. Bohls had already reported to me from Ascension the discovery of *Lepidosiren*, and it is to his kindness that I am indebted for the opportunity of being able to scrutinize a considerable number of this fish, which is rare in our collections, and to submit some specimens of it to examination. In the following pages I give a provisional account of the observations which I have made in so doing, reserving to myself the right of making a further communication on the completion of the investigations which have been commenced †.

* Translated from the 'Nachrichten der k. Gesellschaft der Wissenschaften zu Göttingen,' 1894, no. 2: from an advance copy. The paper was submitted at a meeting of the Society held March 10, 1894.

† A synopsis of the literature on the subject of *Lepidosiren paradoxa*, Fitz., has been given by G. Baur ("Ueber *Lepidosiren paradoxa*, Fitzinger," Zool. Jahrbücher, Bd. ii. 1887, p. 575). I may supplement this by pointing out that, in the list of papers furnished by this author, the titles given under the numbers 18 and 19 belong to one and the same memoir: they are the general and special titles of a paper by Castelnau which was not accessible to Baur.

Since Dr. Bohls obtained his specimens from the neighbourhood of the River Paraguay, while the few which were collected by Natterer and Castelnau came from the region which is watered by the tributaries of the Amazon, it was impossible to overlook the question whether the fish produced by Dr. Bohls are identical with those obtained in Brazil. In order to decide this point, on the one hand I had at my disposal thirty specimens of the fish from Paraguay, while on the other I could only fall back upon the papers of Natterer, Bischoff, Hyrtl, and Castelnau.

That the animals submitted to me belong to the genus *Lepidosiren* is at once rendered sufficiently clear by their general outward appearance; the picture of the entire creature supplied by the existing figures of Natterer, Bischoff, and Castelnau proved this beyond doubt. In length alone the specimens before me fell short of those described by Natterer, who records this dimension as 3 feet and 9 lines; the largest of the fish which I measured was 72 centim. long. I was, however, informed by Dr. Bohls that, owing to the difficulties which had to be faced in connexion with the preservation and transport of the specimens, he found it impossible to bring away the large fish. The largest individuals that he saw were somewhat over 1 metre in length, and were all females; the largest male was 92 centim. long. Dr. Bohls mentioned that the living fish are much darker than the preserved specimens; they are almost black, and in consequence of a thick coating of slime are as slippery as eels.

On going into details it is soon found that the animals before me present individual differences. The larger portion of them, twenty-seven specimens in all, exhibit peculiarities which are not mentioned by any one of the describers of *Lepidosiren paradoxa*, and which render it probable that the latter fish is not identical with those before me; I consider these to be representatives of a species hitherto undescribed, and which I designate *Lepidosiren articulata*. Five other specimens, on the other hand, exhibit a structure which entirely corresponds with the description of *Lepidosiren paradoxa* given by Natterer, Bischoff, and Castelnau, to which species I consequently refer them. In accordance with Günther's explanation, I regard the species *L. dissimilis*, created by Castelnau, as identical with *Lepidosiren paradoxa*.

I will next proceed to give the dimensions of two males of almost equal size belonging to the two species:—

	<i>L. articulata.</i> centim.	<i>L. paradoxa.</i> centim.
Total length.....	57	57·5
Distance of the anus from the tip of the snout.....	40·1	40
Distance of the anterior margin of the eye from the tip of the snout.....	2·1	1·5
Distance of the posterior angle of the mouth from the tip of the snout ..	2·5	1·5
Distance of the branchial aperture from the same	6·5	5·3
Internal distance between the eyes	2·4	2·05
Diameter of the eye	·3	·3
Height of the branchial aperture	1	·8
Length of the anterior extremity	2·6	3·1
Height of the base of the anterior extremity	·4	·2
Thickness of the base of the anterior extremity	·2	·1
Length of the posterior extremity	3·8	4·9
Height of the base of the posterior extremity	·8	·5
Thickness of the base of the posterior extremity	·9	·3
Length of the anal aperture	·6	·6
Circumference behind the anterior extremity	15·5	14
Circumference in front of the posterior extremity	16	14

In the above figures, which have a merely conditional value, differences are seen which are distinctly expressed in the general appearance of the animals. The fact that *L. articulata* appears somewhat thicker than *L. paradoxa* may be due to differences in the state of nourishment or preservation, and is to be disregarded for the present. The differences in the head and in the appendages, on the other hand, are independent of this. The portion of the head forming the snout is shorter in *Lepidosiren paradoxa*, and is more decidedly conical than in the case of *L. articulata*; the distance of the eye and of the posterior angle of the mouth from the tip of the snout is smaller in the former than in the latter; in *Lepidosiren paradoxa* the posterior circumference of the eye lies almost above the posterior angle of the mouth, while in *L. articulata* it lies somewhat in front of it. A line drawn from the anterior circumference of the eye horizontally towards the margin of the snout meets this in the case of *L. paradoxa* at the sloping lateral portion, and is equal in length to four times the diameter of the eye, while in *L. articulata* it impinges upon the broad anterior margin of the snout and is six times as long as the diameter of the eye. Owing to the greater distance of the branchial aperture from

the tip of the snout, the entire cephalic portion of *L. articulata* appears longer than that of *L. paradoxa*. The occipital region in the latter is more strongly arched than in *L. articulata*; the profile of *L. paradoxa* consequently makes a more marked descent towards the tip of the snout than does that of *L. articulata*, whereby the head of *Lepidosiren paradoxa* acquires the sharper conical form which is seen in the figures of Natterer, Bischoff, and Castelnau. This is especially evident if the heads of the two fishes are compared together when looked at from above. *Lepidosiren paradoxa* then appears to have a pointed snout, since the portion of the head lying in front of a line connecting the eyes is sharply conical, while the less narrowed snout of *L. articulata* is bluntly rounded. These differences in the shape of the head, which are occasioned by the conditions of the skeletal parts, are accordingly to be regarded as constant.

The measurements quoted above show a difference between the two species in the size of the extremities, the posterior of which exhibits a sexual dimorphism in each case. But no great value is to be attributed to these differences, since the size of the extremities appears to vary, and is influenced by injuries which afterwards heal up. The extremities of *Lepidosiren paradoxa* are in general longer and more slender than those of *L. articulata*; in both species the posterior appendage is stronger than the anterior, and in it the difference between the two species is especially evident, since in *L. articulata* it is generally stouter than in *Lepidosiren paradoxa*, in which it is of a slender conical shape. The anterior extremities of *Lepidosiren articulata* were generally flattened and furnished with a slight marginal border. This was not so strongly marked in those of *Lepidosiren paradoxa*. The posterior extremities of the males of *L. articulata* are longer and thicker than in the females of the same species, and also are probably thicker than those of *L. paradoxa*. What is more striking than anything else, however, is that while in the females of *L. articulata* the posterior extremities are perfectly smooth, as they are also represented in the figures of the female of *Lepidosiren paradoxa*, in the case of the male animals these appendages bear upon the median and dorsal region a thick growth of close-packed pale-coloured papillæ, of a flattened leaf-shaped form, which are set in tufts upon a common base. These papillæ were most strongly developed in the largest specimens, where they formed a thick brush-like coat, which, with the exception of a short basal area, extended over the entire length of the appendage. In other specimens only a median portion of the extremity was

covered by the papillæ, and in smaller examples I found that merely a low fringe of them was present. The male *Lepidosiren paradoxa* likewise exhibits these structures, which vary in the extent to which they are developed, just as in *Lepidosiren articulata*; the leaf-like form of the papillæ, however, is not so pronounced, and they are more filiform in shape. Since no mention is made of a similar equipment in the case of the posterior appendage of the female of *Lepidosiren paradoxa*, which was previously examined, we are probably justified in taking it for granted that in the case of this species also a sexual character is herein displayed.

The unpaired fin-membranes agree in the two species, and are disposed in the manner previously recorded for *Lepidosiren paradoxa*.

The distance of the anus from the tip of the snout is nearly the same in the examples measured; the position of the anus, on the contrary, is strikingly variable. Bischoff and Castelnau figure it as situated upon the left side of the body to the side of the median plane. In the animals before me the anus occupies this position in the case of eleven males of *Lepidosiren articulata*, while in twelve males and two females it lies upon the right half of the body. In their figures of *Lepidosiren paradoxa*, Natterer, Bischoff, and Castelnau show the anus upon the left side of the body in the female, while I met with it lying on the left in three males, and in two others, on the contrary, on the right. The position of the anal opening is consequently variable, and is not to be regarded as of any value for the purposes of specific diagnosis, nor probably even as a sexual character.

The epidermis of the two species shows a difference which appears to me to be characteristic. In *Lepidosiren paradoxa* the coat of scales is distinctly visible, and upon the head can be traced right towards the front; it is remarkable that in the cephalic region the edges of the scales are directed anteriorly, as has, moreover, been represented by Natterer; towards the ventral side the scales diminish in size. In *Lepidosiren articulata* the coat of scales is covered, and to an equal degree in the two sexes, by a very much stouter epidermis than in *Lepidosiren paradoxa*; the outlines of the individual scales are consequently very much less distinct; corresponding with the coat of scales the surface of the trunk is covered with more or less regularly intersecting furrows and wrinkles, while the head and also the tail, as well as the unpaired fin-membrane, are perfectly smooth. Specimens were nevertheless met with in which the surface of the body was smooth almost throughout. I should be inclined to regard this

difference as not being specific, but as one rather to be ascribed to conditions of preservation, if all five specimens of *Lepidosiren paradoxa* had not therein presented a striking contrast to the remaining examples of *Lepidosiren articulata*.

The colour of *Lepidosiren articulata* is for the most part a uniform slate-grey; in the case of *Lepidosiren paradoxa*, especially in the anterior region, and particularly upon the ventral surface, a spotted appearance is noticeable, since the marginal portions of the scales are darker than their centres. I have also seen similar markings upon one specimen of *Lepidosiren articulata* which displayed dark spots arranged in rows upon the ventral surface. The specimen of *Lepidosiren paradoxa* dissected by Hyrtl was similarly marked.

In the examples of *Lepidosiren paradoxa* before me the system of the lateral lines is not distinctly recognizable; it is so much the better to be seen in a female *Lepidosiren articulata*. Upon the trunk two lateral lines are present, both of which run from the head to beyond the anus on to the tail, while the lower one is continued for more than half the length of the latter. The upper line lies approximately upon the lower margin of the upper fourth, the lower one upon the upper margin of the lower fourth of the total height of the fish; the upper line is situated in some specimens in a sunken groove. Each line is frequently interrupted and composed of sometimes longer, sometimes shorter, portions. From each line there arise at right angles and at equal distances one behind the other, which seem to me to correspond to the metamerism of the trunk, short lateral branches, which run towards the dorsal and ventral median lines, while part of them also exhibit short processes which pass across the main stem in the opposite direction; on the right side of the body I counted nine such lateral branches on the lower line, and on the upper one only eight; on the left side of the body they were much less distinctly visible. The system of lines upon the head corresponds in its general features to what is represented in the existing figures of *Lepidosiren paradoxa*; the description of the details of its arrangement must be reserved until a future occasion, when it will be accompanied by illustrations. I distinguish an opercular arch, with which the lower lateral line inosculates, and the curve of which extends backwards to the level of the branchial cleft; a mandibular arch, which runs close beneath the margin of the lower jaw, embracing the angle of the mouth; and an orbito-nasal arch, which is in connexion with the superior lateral line, surrounds the eye with a tortuous line above and

below, and terminates in an anteriorly-directed curve upon the front end of the nasal sac. All of these lines are more or less interrupted. In the centre of the occipital region short transverse lines are seen running at nearly equal distances one behind the other. In each portion of the lateral lines there can be seen with the aid of a lens small white flecks equidistant one from another upon a dark ground; these are manifestly the nerve-end-structures. The scales which lie upon the lateral lines are not perforated; the line runs in the anterior portion of the integument, from which the free part of the scale penetrates inwards.

A difference between the two species, which is probably of importance, is presented by the anterior olfactory apertures. In the existing figures showing these in *Lepidosiren paradoxa* they are represented as transversely oval openings lying close together. This agrees with the condition which I find in the fish considered by me to belong to this species. In *Lepidosiren articulata*, on the contrary, the anterior nasal apertures are separated by a triangular process, which runs between them from the margin of the upper lip into the cavity of the mouth; the nasal aperture is circular, and at its anterior margin there is situated a conical papilla. However, I also find a flat papilla in the case of *Lepidosiren paradoxa*.

The skull of *Lepidosiren articulata* exhibits but trifling deviations from the figures given by Bischoff and Hyrtl. I shall give a representation of it later on. The five cartilaginous branchial arches lie freely on each side in the œsophageal wall, without being connected one with another by means of a copula or being joined to the skull; this confirms the statements of Hyrtl with regard to the branchial arches of *Lepidosiren paradoxa*.

The vertebral column of *Lepidosiren articulata* possesses fifty-five pairs of ribs, which agrees with the number given by Bischoff for *Lepidosiren paradoxa*. The end of the vertebral column runs out into a point, with uniform reduction of all parts to form the monocercal tail. The figure which Bischoff has given of the termination of the caudal vertebral column of *Lepidosiren paradoxa* was very probably derived from an animal which had lost and incompletely regenerated the tip of its tail; in this manner the abrupt termination of the posterior end of the notochord there represented is explained.

The results obtained from the study of the skeleton of the limbs are of special importance. The arches in both of the species before me correspond to the figures given of them in the case of *Lepidosiren paradoxa*. In the specimens which I assign to this species the skeleton of the appendages is like-

wise a simple unsegmented cartilaginous rod. In *Lepidosiren articulata*, on the other hand, this portion of the skeleton is distinctly segmented, and that, too, in the case of the anterior as well as the posterior limb; the segments are largest in the basal part, and diminish in size towards the tip. In the case of the male of this species the basal segment in the posterior limb is strikingly enlarged and slightly bent; the terminal joints which succeed it are small, and, taken together, convey the impression of a jointed ray situated upon a larger basal segment. This peculiar condition must, however, be tested by the examination of a larger series of specimens, since in the individual instance in question the structure may be due to an injury which has afterwards healed.

With regard to the internal organization, I am at present only able to state that the faveolate connective tissue figured by Hyrtl as existing in the anterior portion of the body occurs at a similar spot in *Lepidosiren articulata*, but is also found in the posterior region outside the peritoneum. I am inclined to suspect that the tissue in question constitutes lymphatic sacs.

The appearance of the organs lying in the body-cavity of the female of *Lepidosiren articulata* does not seem to me to agree with the figure given by Hyrtl. The ovaries, which are apparently metamERICALLY constricted, are enveloped longitudinally in a fold of yellow fat, and thus remind the observer of the similarly situated testes of the male animal. The difference between what I have observed and Hyrtl's representation is, however, probably a physiological one. It is to be presumed that the specimen dissected by the distinguished Viennese anatomist was a female at the period of complete sexual maturity, in which the fatty masses had disappeared, while the animal which I opened possessed ovaries which were far from being mature, but had stored-up masses of fat instead.

For the present we arrive at the following diagnoses for the two species:—

Lepidosiren paradoxa, Fitz.

Coat of scales distinct; snout conical; nasal apertures transversely oval; limbs with unsegmented cartilaginous axis.

Lepidosiren articulata, sp. n.

Coat of scales more or less concealed by thick epidermis; head and snout longer than in *L. paradoxa*, bluntly rounded off in front; nasal apertures circular, with conical papilla; limbs with segmented cartilaginous axis.